

# PROJECT facts

U.S. DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY

Gasification  
Technologies

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## A NOVEL SORBENT-BASED PROCESS FOR HIGH TEMPERATURE TRACE METALS REMOVAL FROM COAL-DERIVED SYNGAS

### Description

#### CONTACTS

##### **Gary J. Stiegel**

Gasification Technology Manager  
National Energy Technology  
Laboratory  
626 Cochrans Mill Road  
P.O. Box 10940  
Pittsburgh, PA 15236  
412-386-4499  
[gary.stiegel@netl.doe.gov](mailto:gary.stiegel@netl.doe.gov)

##### **Elaine Everitt**

Project Manager  
National Energy Technology  
Laboratory  
3610 Collins Ferry Road  
P.O. Box 880  
Morgantown, WV 26507  
304-285-4491  
[Elaine.Everitt@netl.doe.gov](mailto:Elaine.Everitt@netl.doe.gov)

##### **Gokhan Alptekin**

Principal Investigator  
TDA Research, Inc.  
12345 West 52nd Avenue  
Wheat Ridge, CO 80033  
303-940-2349  
[galptekin@tda.com](mailto:galptekin@tda.com)

Gasification converts coal and other heavy feedstocks into synthesis gas (syngas) that can be used either as a fuel for highly efficient power generation cycles or converted into value-added chemicals and transportation fuels. However, coal-derived synthesis gas contains a myriad of trace contaminants, such as mercury (Hg), arsenic (As), selenium (Se), and cadmium (Cd), that may be regulated in power plants and can act as poisons for fuel cells or catalysts used in downstream chemical manufacturing processes.

This project will develop a chemical sorbent-based process to remove all trace metal contaminants (including Hg, As, Se and Cd) from coal-derived synthesis gas in a single process step at high temperature (500°F). High temperature removal will greatly improve the overall efficiency of the power cycle, because cold gas cleanup systems inherently have to condense the water vapor in the syngas, thus reducing power cycle efficiency by roughly 10% on a relative basis.

In a Small Business Innovative Research (SBIR) Phase II project, TDA Research, Inc. (TDA) developed a high temperature, expendable sorbent for removing catalyst poisons (As and Se) from coal-derived syngas; and in a second SBIR Phase II project, TDA developed a high temperature regenerable Hg sorbent. Unlike commercially available sorbents that physically adsorb Hg and must operate at near ambient temperature, TDA's sorbent operates at an elevated temperature and removes trace metals by forming chemical complexes and amalgams. The SBIR projects have already demonstrated parts of the concept, including the ability of the Hg sorbent to operate without deterioration for at least 40 consecutive absorption/regeneration cycles, that the expendable sorbent has an exceptionally high absorption capacity for arsenic and selenium, and that simultaneous removal of Hg and other trace contaminants from simulated coal-derived syngas is achievable.

### Primary Project Goal

The primary goal is to develop a novel gas cleaning technology for removing multiple trace metals (e.g., Hg, As, Se, and Cd) from coal-derived synthesis gas at high temperature.



## PARTNERS

TDA Research, Inc.

## PROJECT COST

### Total Project Value

\$375,000

### DOE/Non-DOE Share

\$300,000 / \$75,000

## CUSTOMER SERVICE

**1-800-553-7681**

## WEBSITE

[www.netl.doe.gov](http://www.netl.doe.gov)

## Objectives

The objectives of the project are to:

- Design, build, and install a field prototype test unit on a slipstream at a gasification facility.
- Evaluate the performance of the prototype unit on real syngas.
- Analyze the removal mechanisms of the trace metals.
- Determine the impact of other impurities in the coal-derived syngas on the operation of the sorbent.

## Accomplishments

In bench-scale tests, TDA has shown that their sorbent can achieve an exceptionally high absorption capacity for arsenic and selenium using simulated syngas. TDA also showed that the sorbent could remove mercury in a regenerable mode for multiple absorption/regeneration cycles with reasonable capacity and without any degradation in performance. Thus, most of the aspects and technical feasibility of TDA's novel trace metal removal system have already been demonstrated at bench-scale.

## Benefits

Gasification systems will benefit from the development of a chemical sorbent-based process to remove trace metal contaminants from coal-derived synthesis gas at high temperatures in a single process step. High temperature removal will improve the overall efficiency of the power cycle. This process should also reduce the amount of sorbent required relative to currently available options, thus reducing costs for replacement sorbent and waste disposal.



*Test apparatus used to evaluate performance of sorbents*